

Durham Research Online

Deposited in DRO:

09 October 2009

Version of attached file:

Published Version

Peer-review status of attached file:

Peer-reviewed

Citation for published item:

Roberts, C. A. and Buikstra, J. E. (2003) 'The bioarchaeology of tuberculosis: a global view on a re-emerging disease.', Gainesville, FL: University Press of Florida.

Further information on publisher's website:

<http://www.upf.com/book.asp?id=ROBERS03>

Publisher's copyright statement:

Additional information:

Sample chapter deposited. Chapter 6: 'The White Plague Continues.', pp. 262-272.

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in DRO
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full DRO policy](#) for further details.

THE WHITE PLAGUE CONTINUES

Tuberculosis, a disease the West had thought it had all but conquered 20 years ago, shows little evidence of significant decline in the first years of the 21st century. This story is being relived for many reemerging diseases, but we have had to look at the history of TB to understand its future. Tuberculosis is a disease that thrives in poor populations living at high densities and eating an impoverished diet. We must rectify those problems by attending to the world's poverty in its broadest sense. Tuberculosis can potentially be treated, and the afflicted in the world must be given equal access to available therapy, but the total patient, not just the disease itself, should be treated. Advice and education on the best lifestyle to adopt to prevent and/or treat TB should be provided, including issues about preventing and dealing with HIV infection and AIDS. Compliance with treatment should be emphasized to halt the development of multidrug-resistant forms of this infection. Although TB "lacks the pull of HIV, Ebola or malaria [and] no Hollywood movie dramatizes its workaday carnage" (Coghlan and Concar 2001: 29), it could continue to be a major threat to civilization. The development of new drugs and a vaccine that is effective for all is one of the keys to conquering TB.

The decline in tuberculosis at the end of the 19th and into the 20th centuries was mainly due to an improvement in living conditions and, to a lesser extent, the development of and access to antibiotics. The recent increase in disease frequency, however, is also related to drug therapy but in a negative sense. Mutant strains of the tuberculosis bacteria have developed, in addition to poverty, the presence of HIV and AIDS, lack of and access to care, and increases in numbers of people with refugee and/or immigrant status. Although drugs may be available for treatment, there are three main problems today's tuberculosis victims must contend with. First, strains of the tuberculosis bacteria in the body may be resistant to the multiple antibiotics administered; second, the course of therapy may be ineffective because it is not completed; and third, a person may not have any access to therapy. In

effect, in some cases the availability of drug therapy may not be the attraction it once was, and people in the long distant past may not have been as disadvantaged as once was thought.

Some of today's predisposing factors have been described above, but there are many more. It is important to remember, however, that combinations of these many factors, added to a person's or population's beliefs of how tuberculosis is contracted, is important in the final appearance of the infection in an individual. It is inevitable that no one person's tuberculosis is the result of only one predisposing factor. However, compliance with and effective treatment of TB today is very much reliant on how patients view the causes of the disease (Rubel and Garro 1992). If a person thinks that his or her TB is caused by hard manual labor, such work will be avoided and a prolonged treatment with antibiotics may not be followed as a remedy. A patient-centered approach to treatment must be advocated for the future, but the consideration of predisposing factors are crucial to understanding TB in the past.

Our discussion of recent predisposing factors for tuberculosis includes intrinsic factors, such as age, sex, and genetic heritage, as well as many factors that are extrinsic to the individual. Extrinsic factors include socioeconomic status, population density, living conditions, travel and migration, occupation, and proximity to animals. Assessing the degree to which these are relevant in past populations requires an inclusive study of the past, one that is both paleoepidemiological and bioarcheological (Buikstra 1977, Larsen 1997).

Looking first at intrinsic factors, contemporary studies suggest that we can anticipate high frequencies of TB in individuals dying in infancy, during late adolescence and young adulthood, and as older (60 years plus) adults. The young are not generally well represented in the archeological record, and skeletal changes typical of the young, such as *spina ventosa*, are not perfectly pathognomonic. Although we cannot readily identify age ranges for those who died as older adults, we can specify those thought to have died in advance of 50–60 years. Unfortunately, the bones of both the young and the old are more prone to dissolution in marginal archeological environments than are those of individuals dying at other ages. Even so, *spina ventosa* has been identified in young juveniles, for example, at Norris Farms (North American site referenced in chapter 4). Although Johnston (1995) suggests that young adult women are disproportionately at risk for TB, this does not seem to be the case in ancient skeletal material series, such as those from Britain or the ancient Andes (as indicated in chapters 3 and 4, respectively). Given the relative visibility of young adults in the archeological record, coupled with our clinically based expectations, it is not surprising that the majority of TB cases identified here (both Old and New World examples)

involve individuals who have died between the ages of 20 and 35. Few studies of ancient skeletal samples have considered the role of heritage, the notable exception being those of Zias (1998) and Matheson et al. (2000). The possibility of considering human aDNA in concert with disease diagnosis holds the potential for establishing populations and even families at genetic risk for TB. Studies of heritage could also focus upon inherited features of the dentition (Scott and Turner 1997) and the skeleton (Buikstra and Ubelaker 1994, Krogman and Iscan 1986).

Few extrinsic factors have been explicitly studied in parallel with the investigation of tuberculosis in archeological materials. Notable exceptions occur in New World studies where issues of population density/size (Buikstra 1977, 1999, Buikstra and Cook 1981), diet (Buikstra 1992), social stresses (Buikstra 1992, 1999, Buikstra and Williams 1991, Milner and Smith 1990), and occupational risks (Buikstra 1977, Buikstra and Cook 1981, Buikstra and Williams 1991) have been raised. In the Old World there has also been some work on subsistence patterns (Formicola et al. 1987), living environment and immunity (Manchester 1991), dietary stress (Vuorinen 1999), industrialization (Hutás 1999), and population density, urbanism, and craft specialization (Jankauskas 1998). These are summarized in chapters 3 and 4.

A highly balanced nutritious diet with lots of protein is recommended for TB prevention and recovery (Knapp 1989), but for many of the world's poor today this diet is not attainable. In the past an analogous situation presented itself at the transition to agriculture, when diets were less varied, food production was less reliable, and food was lower in protein (Cohen 1989), thus compromising immune systems and making people more susceptible to disease. In addition, some populations may have been lactose intolerant and, again, this would have influenced whether they drank milk, or used it in cooking or not. This must have influenced TB rates in those affected countries. In the Old World, even if infected milk or other dairy products were not consumed, infected meat may have been. Added to this was the presence of an environment conducive to the development of TB in the form of higher population density; poorly ventilated houses; increases in travel, trade, and contact; and contact with domesticated animals (via food, Daborn et al. 1996; droplet infection, Grange 1999; and working with infected products in craft industries, building, and farming). Poverty also compromises immune systems, and if we assume that it was present in the past and may be indicated by skeletal and dental indicators of stress, we can start to correlate the occurrence of TB with poverty. However, this has rarely been attempted (e.g., Knick 1981), probably because skeletal stress markers are nonspecific in aetiology. Occupation and its association with TB has also had little attention. Interpreting a person's occupation from changes in the skeleton has many problems (Jurmain 1999), and specifically linking evidence of TB in a skeleton with an occupation such as mining,

potting, or working with textiles, all which predispose to TB (Bowden and McDiarmid 1994), is an area that would benefit from careful investigation. However, this type of study will not be without problems. What we do know, however, is that at the advent of agriculture in the Old World people were living in close contact, and working, with their domesticated animals (some more than others and for different periods of time in any one day). Therefore, they could potentially contract TB. Clinical data also tell us that travel and migration predisposed people to TB because they may be living in poor conditions in the place to which they migrate, and they may be exposed to new diseases, including TB. Although it may be possible to identify people who have traveled from their place of origin to a new home through analyzing their skeletons (Sealey et al. 1995; Price et al. 2001; Stone 2000), correlating that information with the occurrence of TB has not been attempted in palaeopathology. However, as this remains a very important factor in TB's spread today, it would be beneficial to start considering it as a factor in the past.

We can also reconstruct general ideas about living conditions in the past: house and settlement size, organization of the house, and the relationship of hearths, windows, doors, walls, and roofing materials to ventilation (which may be reconstructed, given the right type of evidence). Furthermore, on the basis of house and settlement size, the numbers of people living there (and in one house) have been inferred. This could provide an indication of the likelihood of transmission of TB. While people working on the palaeopathology of TB have inferred from the evidence that population density and the quality of housing may not have prevented TB from spreading, little work has explored absolute relationships between specific settlement and house organization and TB occurrence in the past, another area that could be pursued. Of course, the development of urbanism and the later (in Europe) onset of the Industrial Revolution helped tuberculosis to take hold of the population. Again, however, many working with the evidence of TB from skeletal remains make general statements that urbanism and increases in population (and trade and contact) allowed TB to increase, although specific and detailed case studies linking skeletal and cultural (socially constructed) data have not been done in the Old World. Nevertheless, most of the data for TB in the past come from a time when populations were increasing and living in close contact with each other, often with poor levels of hygiene.

So what were the most important factors in the past that enabled TB to flourish? Probably higher population density, poverty (encompassing many factors such as diet and living conditions), and contact with animals. Ultimately, as clinical data show (Enarson and Rouillon 1998: 45), the probability of infection is dependent on the number of open cases in the population, the density of bacteria expelled in the sputum and in the surrounding air, the

absolute numbers of people present, and how long people are in contact with infected cases. The presence of the bacteria and of humans is the basis from which TB can claim its victims, but it is the added factors such as poverty, occupation, and travel which enhance a person's likelihood of contracting the infection.

Assessing the impact of tuberculosis on populations in the distant past is much more difficult than today, even though today's frequency rates are flawed in some respects (Grange 1999: 3). Even historical data from the 18th, 19th, and early 20th centuries, despite providing a fuller picture of the disease in its sociocultural context, can be biased and misleading. The evidence for TB from the skeletal and historical records suggests that TB appeared to become a prominent disease beginning in the later Medieval period in Europe, and after A.D. 1000 in North and South America. Of course, the earliest evidence skeletally is well before the first historical data in both the Old and New Worlds (e.g., in Italy). Although the early skeletal evidence is not as plentiful as that of later periods, it is definitely present and its scarcity perhaps represents the lack of human remains excavated from contexts from those earlier dates. While some areas of the Old World have a limited number of early cases, frequency appears to often reflect archaeological activity, and particularly palaeopathological study. Egypt, Poland, and Spain also have early cases, but not in large numbers. Furthermore, several countries (Austria, Lithuania, Britain, and France) have their earliest cases in the 4th–5th centuries A.D. Does this reflect that the conditions for TB in those countries were present, or are these small numbers of cases indicating perhaps that people were migrating into those countries from other infected areas? While the skeletal evidence to date is limited in its extent, the picture is likely to change in future years. In the New World, however, the evidence for skeletal tuberculosis appears to concentrate in areas of highest population density (except in the Aztec and Maya areas). The southeastern and southwestern United States, a small area of Mexico, and Colombia, Venezuela, Chile, and Peru in South America have all revealed tuberculosis in skeletons and/or mummified bodies. Frequencies appear to increase after about A.D. 1000 and continue into the Historic period.

Worldwide, tuberculosis evidence in human remains is uneven. Huge areas of our world have no evidence. While accepting that boundaries for countries and names have changed considerably through time, many countries have no reports of ancient TB. In the Americas, Alaska, Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, the Caribbean Islands, the Guianas, Suriname, Ecuador, Brazil, Bolivia, and Uruguay report no TB evidence. Similarly, Iceland, Greenland, Korea, Taiwan, and the vast majority of the Russian Federation, in addition to Burma, Laos, Kampuchea, Vietnam, Malaysia, Micronesia, Indonesia, the Philippines, Melanesia, Polynesia, and Australia and New Zealand have no evi-

dence. Furthermore, the former Soviet states of Georgia, Azerbaijan, Turkmenistan, Uzbekistan, Tajikistan and Kyrgyzstan, and Afghanistan, Iran, Iraq, Saudi Arabia, Yemen, Oman, United Arab Emirates, India, Pakistan, Bhutan, Bangladesh, Nepal, Tibet, and sub-Saharan Africa are devoid of ancient TB. In Europe, Belgium, the Netherlands, Luxemburg, the former Yugoslavia except present-day Serbia, Macedonia, Albania, Bulgaria, Romania, Moldova, the Ukraine, Belarus, Latvia, and Estonia reveal no skeletal TB. Of course, this picture could be painted of any disease whose history is being traced, but archeology is a very large jigsaw puzzle for which many of the pieces are often missing. Judgements of the data often rest on meager evidence but as the years go by more evidence accumulates and the painted picture may change, as it has for venereal syphilis (Dutour et al. 1994) and will for tuberculosis.

Secondary sources of evidence for tuberculosis have also been considered, although they frequently provide an interpretive challenge. Medical historians will always read their data from the written and illustrated evidence but care must be undertaken with interpretation. The earliest accepted written evidence for TB appears to come from China from 2700 B.C. (Keers 1981), although numerous Greek and Roman writers around the 1st centuries B.C. and A.D. describe what appears to be TB (Meinecke 1927). More recently, the written evidence becomes more common, and by the mid-1600s in England 20 percent of all deaths were reported to be due to TB (Lutwick 1995). Even though the conditions needed for TB were present in the parts of the world where TB rates were high from the 1600s onward, we must not take the data at face value, data that could be inaccurate (Hardy 1994). For many reasons, TB may have been diagnosed wrongly, or TB may not have been diagnosed at all (because the diagnostician was incompetent, or because the stigma attached to TB made diagnosis not advisable). Therefore, even if we do in fact have these data for more recent periods of time, they do not necessarily provide us with a fully accurate picture of TB frequency rates. Diagnosis of TB in the more distant past seemed to have relied on recognition of the signs and symptoms, but no other method could be used at this time. One wonders whether this method was as good as any before the discovery of x-rays at the end of the 19th century and the development of sputum and blood tests. Likewise, the many hunched-backed individuals depicted in art need to be considered critically if they are to be used as indicators of TB in a population. Many diseases could cause this appearance (Evans 1998). Likewise, the pale, thin young women dressed in white (Clarke 1962) that are so often used as indicators of TB could easily be representing other health problems, such as severe anemia, anorexia nervosa, and cancer. Written and illustrated evidence for TB "fleshes out" the hard data extracted from the remains of humans themselves but it needs to be considered with care.

When considering how care and treatment have developed over deep time, it is important to return to the question of how populations viewed the reasons for the infection appearing within their society. Also relevant is whether associated stigma influenced their feelings about the disease, and whether this developed when a person showed external signs of the disease, or whether it developed through hearsay within the community. We certainly know that TB is stigmatized today (Kelly 1999), but there is no evidence from the past that affected people were buried differently. While we have evidence about how TB was diagnosed and treated, we cannot assume that everybody in all populations, for all periods of time and all locations, obtained treatment. Furthermore, if they did, we cannot be sure treatments were always successful. The therapeutics of two thousand years ago may not have been what we would expect today or have been successful, but they would have been related to concepts of disease at that time. The question of whether males and females were treated differently in the distant past is hard to determine. Even though we know that access to health care today in some societies discriminate between the sexes (Hudelson 1999), we cannot assume that for the past. However, access to care, generally, is not equal today around the world (Zumla et al. 1999, Shaw et al. 2000), and it is unlikely it was in the past. Many factors influence who gets treated and when, but stigma associated with TB may prevent people from getting access to treatment they could readily have (Foster 1999).

While prevention and treatment today focus on vaccination, chemotherapy, and eliminating poverty in both developed and developing worlds, our evidence from the past for treatment is more varied, which indicates the cultural diversity of populations in their belief systems with respect to health. It also suggests that prior to the discovery of the tubercle bacillus at the end of the 19th century and development of a vaccine and drugs in the 20th century, treatment was a matter of trial and a lot of error. Bloodletting, the use of emetics, recommendations for urinating, defecating, and sweating (Daniel 1997), and the use of leeches to drain painful tuberculous joints (Smith 1988) all suggest that beginning with the Graeco-Roman era, treatments were directed at balancing the humors, that is, letting the disease drain away from the body with other substances. In addition to this, gaining lots of rest, fresh air, sun, and a high-protein balanced diet, preferably at altitude or by the sea in a pleasant environment, was deemed beneficial. Of course, the development of sanatoria from the 17th century onward for tuberculous victims helped at least to give hope to patients and their families (Dormandy 1999), although their worth as curing institutions has been questioned by many.

More unconventional remedies also developed, such as treatment with specific herbs, the ingestion of meat and milk from animals (maybe inducing some immunity), inhalation of various substances, including the smoke

of burning dung, and "touching for the King's Evil." It is highly probable that these remedies developed as a response to a health problem that was both increasing and little understood. In many respects these therapeutic attempts at controlling the disease may have been last resorts or were developed to provide an indication that at least something was being tried and that the patient and family had some hope of a cure (although slender and lacking in a scientific basis). Linking skeletons from the distant past with TB to evidence for treatment can be attempted only in a very broad sense. We can make generalizations about what treatments were available in a specific period of time. However, we cannot then say that a particular individual had treatment because of the many factors that affect whether a person actually gets access to care and the sheer lack of evidence to make that link.

Future studies of skeletal tuberculosis involve several cautions and a number of recommendations. For some of the cases examined for this book, certain crucial diagnostic information was lacking. In order to generate quality data, everybody working in palaeopathology should be aware of the need to standardize data collection (Buikstra and Ubelaker 1994), be careful of recording methods and diagnoses (Ortner 1991), and provide data in such a way that actual prevalence rates for TB can be formulated. At the moment, most data are presented only as the numbers of individuals affected in a population rather than providing additional information about, for example, the numbers of spines affected by TB compared to the number observed (see Waldron 1994 for comments on determining true prevalence rates for disease). Taking a population-based, and more problem-oriented, perspective on TB would also move us away from considering "interesting" cases of TB scattered around the globe (Larsen 1997). It is in the Americas where most of the population-based work in palaeopathology has been undertaken to date, as Mays (1997) clearly shows. The need for the future in the palaeopathology of TB is to consider the biological evidence closely linked with cultural context, which will then allow us to generate ideas about why TB occurred at a particular point in time in a specific location in a certain population.

Another concern is whether the diagnostic criteria palaeopathologists are using to identify TB are ideally suited to skeletal material. We know that our skeletal evidence is rather meager compared to historical sources for TB, but this may be explained by the diagnostic methods we use. Nevertheless, the low frequency of skeletal TB in affected individuals has been noted by many clinical texts, so perhaps we should not expect much evidence. However, when we consider some of the subtle bone forming and resorptive changes we can identify in skeletal remains, which cannot be seen on conventional radiographs (e.g., Santos 2000, Santos and Roberts 2001), we must wonder whether the clinical diagnostic criteria (e.g., Resnick 1995)

A combination of similar and differing factors quite clearly has predisposed past human populations to contracting TB. All of the factors in the past are relevant to today's populations, although the presence of HIV and AIDS and multiple-drug resistance have undoubtedly increased the tuberculous load in our contemporary world. Tuberculosis has made a considerable impact on humans and other animals for several thousands of years, and although in the recent past it declined for a short time, it seems set to be with us for some time to come. We must remember that times have changed; the small hunter-gathering communities of the past, which did not experience TB as a major threat to their existence, have vanished. We live in an increasingly complex world where "diseases are global [and] no country, city or neighbourhood is an island" (Coghlan and Concar 2001: 33).